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# THE DERBY UPM DEMONSTRATION PROJECT

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## 1.0 INTRODUCTION: Project Objectives

The Urban Pollution Management (UPM) Research Programme[1,2] has been the UK water industry's response to the need to limit the risk of transient and potentially serious pollution of receiving waters resulting from intermittent discharges, such as combined sewer overflows. The UPM Procedure described in the forthcoming UPM Manual[3] will play a major role in developing cost effective integrated wastewater system solutions to meet the requirements of the Urban Wastewater Treatment Directive for the control of wet weather discharges.

The UPM Demonstration Project, which is jointly funded by UKWIR and the NRA through FWR, started in 1993. The main objectives of this project are:

(i) to carry out a comprehensive application of the UPM Procedure in a selected study catchment.
(ii) to identify a notional UPM strategy solution to the specific problems of the selected study catchment; and
(iii) to contrast the above solution with alternatives derived by applying traditional planning procedures.

The first stage of the project was the selection of a study catchment to meet the project requirement specification. Derby was chosen after discussion with industry and the NRA. A high degree of effort is directed towards developing a sewerage rehabilitation solution to the problems in Derby. The UPM Demonstration project will complement this work and has received direct local support from Severn Trent Ltd and Severn Trent Region of the NRA.

## 2.0 Wastewater System Performance and Environmental Impact in Derby

Severn Trent Water's recently completed drainage area study programme highlighted considerable flooding and pollution problems throughout the Derby catchment. High levels of investment will be needed to solve these problems by increased pumping capacity at the inlet to Derby STW and the rationalisation and upgrading of a large number of combined sewer overflows. Both the complexity of the sewer system and the multiple uses of the River Derwent complicate the identification of an effective solution.

The Derby Sewer System, is described in detail elsewhere[4]. The Eastern Interceptor drains the east bank of the Derwent and the Northern and Southern Interceptors and Chellaston Trunk Foul Sewer (CTFS) serve the west bank. The Alvaston overflow forms the major relief point for the sewers on the west bank. The Southern Surface Water Sewer (SSWS), constructed to alleviate flooding in the city centre, receives significant CSO spills and ultimately discharges into a flood relief channel (Cut D) on the Derwent below Derby.

The River Derwent upstream of Derby is NWC class 1B and General Quality Assessment (GQA) grade B. Its quality deteriorates through Derby to Raynesway. Derby sewage works discharges into Cut C where increased BOD and ammonia cause a change of grading to NWC Class 2 and

Table 1 - Configuration of MOSQITO models

| Original WALLRUS Model | Original Number of Pipes | MOSQITO Model | Number of Pipes |
|---|---|---|---|
| Northern Interceptor | 1247 | A | 253 |
| Southern Interceptor | 1024 | A | 197 |
| Chellaston Trunk Foul Sewer | 144 | A | 144 |
| SSWS | - | | - |
| TOTAL | 2415 | | 594 |
| Eastern Interceptor | 1835 | B | 249 |

The Derby sewage treatment works has a design DWF of 118 Ml/day and currently receives an average of 104 Ml/day from the sewerage system, plus 17 Ml/day of industrial effluent. The works has three process stages, primary sedimentation, high rate filtration and conventional alternating filtration. All processes at the sewage works are represented in the STOAT model.

The MIKE 11 model of the River Derwent runs from Little Eaton above Derby to the confluence with the Trent below Draycott. This enables model boundaries to be defined by existing continuous flow measurement and quality monitoring stations.

(ii) Data Collection

A data collection programme has been implemented to allow dry weather and wet weather calibration and verification of the models. The specified data collection requirements for each model are summarised in Table 2. Sample collection intervals and analysis varied between sites, and for different events. Four river monitoring sites were operated by the NRA. All other data were collected by WRc. Sample analysis was carried out in the laboratories of Severn Trent Water and the NRA.

Table 2 - Data Collection Requirements

| | DWF Data | | Storm Data | |
|---|---|---|---|---|
| | Sampling Points | Flow Measurement | Sampling Points | Flow Measurement |
| (i) MOSQITO | 10<br>3 x 24 hour duration | 10 | 8 | 8 |
| (ii) STOAT | 7<br>3 days continuous | 8 | 8<br>3 days continuous | 6 |
| (iii) MIKE 11 | 7<br>3 x 24 hour duration | 3 | 10<br>4 days continuous | 3 |

The survey period commenced in May 1994. All specified DWF data had been collected by the end of June. The original intention was to collect 3 storm events within an 11 week survey period. However, no suitable rainfall occurred within this period, when rainfall was less than 50% of the long term average. The survey was extended by a further 11 weeks with additional support from Severn Trent Water Ltd and the NRA. A suitable storm event was captured on 2 October. At this stage it was agreed to continue the study with a single storm event to allow completion of the project within schedule.

**The Derby UPM Demonstration Project**
**Bob Crabtree - WRc**
**Wayne Earp - Severn Trent Water**
**Peter Whalley - NRA**

**Question** Richard Ashley University of Abertay
Are you only going to use 1 storm for the verification?
**Answer**
The model was calibrated on one storm because that was all that was available. There is a woeful inability to predict long term rainfall People will have to get used to that on this type of study because of the time and resources limitations. As far as results ammonia results were concerned it may be that Sundays are different to week days. We were mainly looking at DWF verification and the results look good. It would be nice too have had more storm events.

**Question** Richard Ashley University of Abertay
In your opinion will recent developments in on line monitoring contribute to solving the problems seen in this study?
**Answer**
Yes, if you can get on-line monitors to measure the right parameters, SS BOD and COD very difficult to monitor the technology does not exist. On line OK for DO and ammonia levels this will help this will help the river the modelling side. Considerations should also be given to the cost of developing these new sensors with the cost of sampling and the relevant merits of both approaches.

**Question** Written question from Gareth Catterson ADS Environmental Services
Given that the model was calibrated on the single observed storm data can you comment on the validity of the claims about a successful demonstration of the UPM approach given that no further model verification was undertaken?

**Answer**
Practical considerations limited the extent of data capture as indicated in the paper. Data were sufficient to allow dry weather calibration and verification of MOSQITO. A further storm event would have been necessary and desirable to verify the MOSQITO model beyond the calibration stage achieved under storm conditions. This has been taken into